## IN THE SPECIFICATION

Please amend the Title on page 1 as follows:

WAVEFRONT ABERRATION MEASURING METHOD AND ~~UNIT~~ APPARATUS, EXPOSURE APPARATUS, DEVICE MANUFACTURING METHOD, AND DEVICE

Please replace the paragraph beginning at page 1, line 9, with the following rewritten paragraph:

The present invention relates to a wave-front aberration measuring method and unit, an exposure apparatus, a device manufacturing method, and device, and more specifically to a wave-front aberration measuring method and unit for measuring a wave-front aberration characteristic of an optical system to be examined, an exposure apparatus comprising the wave-front aberration measuring ~~unit~~ apparatus, a device manufacturing method using the exposure apparatus and a device manufactured by the device manufacturing method.

Please replace the paragraph beginning at page 2, line 19, with the following rewritten paragraph:

Various techniques have been suggested for measuring the wave-front aberration ~~in~~ of an optical system ~~subject to measurement~~ such as a projection optical system installed in an exposure apparatus in the state where the optical system is actually installed in the apparatus. Among the various techniques, the Shack-Hartmann technique is attracting attention which divides the wave-front on the pupil plane of the projection optical system into a plurality of square areas (may actually divide; hereinafter, called "divided wave-front portions") and

measures the gradient of each divided wave-front portion to obtain aberration of the portion and thus aberration of the whole wave-front.

Please replace the paragraph beginning at page 5, line 15, with the following rewritten paragraph:

Moreover, because optical elements such as lenses forming part of the optical system such as a projection optical system have a cylinder-symmetrical shape, the wave-front aberration ~~in~~ of the optical system is suitably expressed in polar coordinates. Meanwhile, in measuring the wave-front aberration according to the Shack-Hartmann technique the wave-front is divided by a two-dimensional orthogonal grid. Because, as described above, the coordinate system suitable to express the wave-front aberration and the coordinate system for detecting imaging positions of the pattern are different in form, the aliasing may cause the component of an order ~~term~~ to blend into the component of another order ~~term~~ in the measuring result.

Please replace the paragraph beginning at page 6, line 1, with the following rewritten paragraph:

Therefore, measuring the wave-front aberration according to the prior art Shack-Hartmann technique has a limit to improving the accuracy in measuring the wave-front aberration because of the possibility of cross talk between order terms where, when the wave-front aberration is expanded in a basis (or series), the aberration component of an order ~~term~~

blends into the aberration component of another order ~~term~~ in the measuring result.

Please replace the paragraph beginning at page 6, line 11, with the following rewritten paragraph:

This invention was made under such circumstances, and a first purpose of the present invention is to provide a wave-front aberration measuring method and unit that can improve accuracy in measuring the wave-front aberration ~~in~~ of an optical system ~~subject to measurement.~~

Please replace the paragraph beginning at page 6, line 16, with the following rewritten paragraph:

Furthermore, a second purpose of the present invention is to provide an exposure apparatus that can accurately transfer a ~~given~~ pattern onto a substrate.

Please replace the paragraph beginning at page 6, line 23, with the following rewritten paragraph:

According to a first aspect of the present invention, there is provided a wave-front aberration measuring method with which to measure ~~a~~ wave-front aberration ~~in~~ of an optical system ~~subject to measurement~~, ~~said~~ the measuring method comprising measuring~~, first~~, aberration components of a first set of ~~order terms~~ orders out of a plurality of aberration components ~~of order terms of a predetermined basis in which the wave-front aberration in said optical system is expanded~~ obtained by expanding the wave-front aberration of the

optical system using a predetermined basis; calculating correction information for aberration components of a second set of ~~order terms~~ orders based on ~~a predetermined order term's~~ aberration ~~component~~ components of predetermined orders out of the measured aberration components of ~~said~~ the first set of ~~order terms~~ orders; measuring aberration components of ~~said~~ the second set of ~~order terms in said~~ orders of the optical system; and correcting the result of ~~said~~ the measuring of aberration components of ~~said~~ the second set of ~~order terms~~ orders based on ~~said~~ the correction information. Here, the number of ~~order terms~~ orders composing the set may be one, not being limited to more than one. That is, for example, the first set of ~~order terms~~ orders may consist of one order ~~term~~ or a plurality of ~~order terms~~ orders. Herein, the word "set" has such meaning.

Please replace the paragraph beginning at page 7, line 17, with the following rewritten paragraph:

According to this, first, aberration components of a first set of ~~order terms~~ orders are measured, for example, upon making the optical system, when it is possible to very accurately measure higher-order, as well as lower-order, terms of a predetermined basis (series) in which the wave-front aberration is expanded, because enough time can be spent on measurement and restriction on measurement resources provided is little. Correction information for aberration components of a second set of ~~order terms~~ orders to be measured later is calculated based on a predetermined order term's aberration component out of the aberration components of the first set of ~~order terms~~ orders measured.

Please replace the paragraph beginning at page 8, line 2, with the following rewritten paragraph:

Then, aberration components of the second set of ~~order terms~~ orders in the optical system are measured, for example, after installing the optical system in the apparatus. Upon the measurement, ~~order terms~~ orders' aberration components that are expected to vary since the making thereof are measured. And the result of measuring aberration components of the second set of ~~order terms~~ orders is corrected based on the correction information. As a result, aberration components of the second set of ~~order terms~~ orders can be accurately obtained.

Please replace the paragraph beginning at page 8, line 12, with the following rewritten paragraph:

In the wave-front aberration measuring method according to this invention, ~~the expansion in said predetermined basis may be an expansion in a set of~~ the plurality of aberration components are obtained by expanding the wave-front aberration of said optical system using fringe Zernike polynomials. Here, the "expansion in a set of fringe Zernike polynomials" means an expansion given by the expression (1),

$$W(\rho,\theta) = \sum_i \{\ Z_i \cdot f_i(\rho,\theta)\ \} \quad \cdots (1)$$

where W(ρ,θ) represents the wave-front (aberration) expressed in polar coordinates (ρ,θ).

Please replace the paragraph beginning at page 8, line 20, with the following rewritten paragraph:

$\rho,\theta$) ($i = 1$ through 36) in the expression (1). The wave-front (aberration) is expanded in Zernike polynomials, each of which expresses an n'th order $m\theta$ term that is a product of an n'th order polynomial including radial distance $\rho$ to the n'th power and a trigonometric function of angular coordinate $\theta$ multiplied by m, and in the expansion in fringe Zernike polynomials, terms are arranged in ascending order of the sum $(n + m)$ and, when values of the sum are the same, in ascending order of n. The value of i in the expression (1) denotes an order in the expansion in fringe Zernike polynomials. Incidentally, coefficients of higher than first ~~order terms~~ orders and not coefficient $Z_1$ of the first order ~~term~~ are measured in the measurement of wave-front aberration according to the Shack-Hartmann technique.

Please replace the paragraph beginning at page 9, line 23, with the following rewritten paragraph:

In the wave-front aberration measuring method according to this invention, ~~said~~ the first set of ~~order terms~~ orders may include all of a lowest order ~~term~~ through a first ordinal order ~~term~~ in ~~said~~ the expansion, and ~~wherein said~~ the second set of ~~order terms~~ orders may include all of ~~said~~ the lowest order ~~term~~ through a second ordinal order ~~term~~ in ~~said~~ the expansion, ~~said~~ the second ordinal being lower than ~~said~~ the first ordinal. Because, as described above, coefficient $Z_1$ of the first order ~~term~~ is not measured in the measurement of wave-front aberration according to the Shack-Hartmann technique, the lowest order is the second order.

Please replace the paragraph beginning at page 10, line 7, with the following rewritten paragraph:

In the wave-front aberration measuring method according to this invention, ~~said~~ the predetermined ~~order term~~ orders may be included in ~~said~~ the first set of ~~order terms~~ orders and not included in ~~said~~ the second set of ~~order terms~~ orders; calculating ~~said~~ the correction information may comprise calculating a first wave-front in which aberration components of other orders than the predetermined orders out of the measured first set of orders are zero ~~with letting aberration components of other order terms of said first set of order terms measured than said predetermined order term be zero~~ and calculating as ~~said~~ the correction information respective correction amounts for aberration components of ~~said~~ the second set of ~~order terms~~ orders based on a model for a measuring system that measures aberration components of ~~said~~ the second set of ~~order terms~~ orders and ~~said~~ on the first wave-front, and in correcting based on said correction information, the measured aberration components of ~~said~~ the second set of ~~order terms measured~~ orders may be individually corrected ~~based on said correction information~~.

Please replace the paragraph beginning at page 10, line 23, with the following rewritten paragraph:

In the wave-front aberration measuring method according to this invention, ~~said~~ the predetermined ~~order term~~ orders may be included in ~~said~~ the first set of ~~order terms~~ orders and not included in ~~said~~ the second set of ~~order terms~~ orders; calculating ~~said~~ the correction information may comprise calculating as ~~said~~ the correction information a first wave-front in

which aberration components of other orders than the predetermined orders out of the measured first set of orders are zero ~~with letting aberration components of other order terms of said first set of order terms measured than said predetermined order term be zero~~, and correcting based on ~~said~~ the correction information may comprise calculating a second wave-front that has aberration components of ~~said~~ the second set of ~~order terms~~ orders measured by a measuring system that measures aberration components of ~~said~~ the second set of ~~order terms~~ orders, calculating a third wave-front by correcting ~~said~~ the second wave-front based on ~~said~~ the first wave-front and calculating corrected aberration components of ~~said~~ the second set of ~~order terms~~ orders, based on ~~said~~ the third wave-front and a model for ~~said~~ the measuring system.

Please replace the paragraph beginning at page 11, line 13, with the following rewritten paragraph:

In the wave-front aberration measuring method according to this invention, measuring aberration components of ~~said~~ the second set of ~~order terms~~ orders may comprise forming a plurality of pattern images by dividing ~~by use of a predetermined optical system a~~ wave-front of light having passed through ~~said~~ the optical system using a predetermined optical system; and calculating aberration components of ~~said~~ the second set of ~~order terms~~ orders, based on positions of ~~said~~ the plurality of pattern images ~~formed~~.

Please replace the paragraph beginning at page 11, line 22, with the following rewritten paragraph:

In the wave-front aberration measuring method according to this invention, measuring aberration components of ~~said~~ the second set of ~~order terms~~ orders may comprise: ~~imaging,~~ ~~after~~ placing ~~at the object plane of said optical system~~ a plurality of divided pattern areas on which a plurality of patterns are formed, at the object plane of said optical system, said patterns producing ~~on each of which a pattern that produces~~ light passing through ~~a~~ respective ~~area~~ areas of a plurality of areas on the pupil plane of ~~said~~ the optical system; ~~is formed~~, ~~said patterns formed on said~~ imaging images of the plurality of patterns respectively formed on the plurality of divided pattern areas through ~~said~~ the optical system; and calculating aberration components of ~~said~~ the second set of ~~order terms~~ orders, based on positions of images of ~~said~~ the ~~pattern, formed~~ plurality of patterns imaged by ~~said~~ the optical system.

Please replace the paragraph beginning at page 12, line 7, with the following rewritten paragraph:

According to a second aspect of the present invention, there is provided a wave-front aberration measuring ~~unit~~ apparatus which measures ~~a~~ wave-front aberration ~~in~~ of an optical system ~~subject to measurement~~, ~~said~~ the measuring ~~unit~~ apparatus comprising a storage unit that stores ~~calculated~~ correction information for aberration components of a second set of ~~order terms~~ orders, the correction information being calculated based on ~~a predetermined order term's~~ aberration ~~component~~ components of predetermined orders out of aberration components of a first set of ~~order terms measured before~~ orders out of a plurality of

aberration components obtained by expanding ~~of order terms of a predetermined basis in which~~ the wave-front aberration ~~in~~ of ~~said~~ the optical system ~~is expanded~~ using a predetermined basis; a measuring system that measures aberration components of ~~said~~ the second set of ~~order terms~~ orders of the wave-front aberration ~~in~~ of ~~said~~ the optical system; and a correcting unit coupled to the storage unit and the measuring system, which ~~that~~ corrects the measuring result of ~~said~~ the measuring system ~~with said~~ using the correction information.

Please replace the paragraph beginning at page 12, line 23, with the following rewritten paragraph:

According to this, a correcting unit corrects aberration components of a second set of ~~order terms~~ orders measured by a measuring system with calculated correction information for aberration components of the second set of ~~order terms~~ orders based on a predetermined order term's aberration component out of aberration components of a first set of ~~order terms~~ orders measured before. That is, the wave-front aberration measuring ~~unit~~ apparatus of this invention measures the wave-front aberration ~~in~~ of the optical system using the wave-front aberration measuring method, so that the wave-front aberration can be accurately measured.

Please replace the paragraph beginning at page 13, line 6, with the following rewritten paragraph:

In the wave-front aberration measuring ~~unit~~ apparatus according to this invention, ~~the expansion in said predetermined basis may be an expansion in a set of~~ the plurality of

aberration components is obtained by expanding the wave-front aberration of the optical system using fringe Zernike polynomials.

Please replace the paragraph beginning at page 13, line 10, with the following rewritten paragraph:

Further, in the wave-front aberration measuring ~~unit~~ apparatus according to this invention, ~~said~~ the measuring system may comprise a wave-front dividing device ~~that divides a~~ positioned to divide wave-front of light having passed through ~~said~~ the optical system to form images of a plurality of pattern~~-images~~; and an aberration-component calculating unit coupled to the correcting unit, which ~~that~~ calculates aberration components of ~~said~~ the second set of ~~order terms~~ orders, based on positions of ~~said~~ the mages of the plurality of ~~pattern images formed~~ patterns.

Please replace the paragraph beginning at page 13, line 19, with the following rewritten paragraph:

Here, ~~said~~ the wave-front dividing device may be a micro-lens array where lens elements are arranged in a matrix.

Please replace the paragraph beginning at page 13, line 22, with the following rewritten paragraph:

Yet further, ~~said~~ the measuring system may comprise: a pattern-formed member that is placed on the object plane's side of ~~said~~ the optical system and has a plurality of divided

pattern areas on ~~each of~~ which ~~a pattern that produces~~ a plurality of patterns are formed, the patterns producing light passing through ~~a~~ respective ~~area~~ areas of a plurality of areas on the pupil plane of ~~said~~ the optical system ~~is formed~~; and an aberration-component calculating unit coupled to the correcting unit, which ~~that~~ calculates aberration components of ~~said~~ the second set of ~~order terms~~ orders, based on positions of images of ~~said pattern, formed by said optical system~~ the plurality of patterns.

Please replace the paragraph beginning at page 14, line 4, with the following rewritten paragraph:

According to a third aspect of the present invention, there is provided an exposure apparatus which transfers a ~~given~~ pattern onto a substrate ~~by illuminating said substrate with exposure light~~, ~~said~~ the apparatus comprising an exposure apparatus main body that comprises a projection optical system arranged on the optical path of ~~said~~ exposure light; and a wave-front aberration measuring ~~unit~~ apparatus according to this invention with ~~said~~ the projection optical system as an optical system ~~subject to measurement~~.

Please replace the paragraph beginning at page 14, line 14, with the following rewritten paragraph:

According to this, a ~~given~~ pattern is transferred onto substrates through a projection optical system whose optical characteristic has been accurately measured by the wave-front aberration measuring ~~unit~~ apparatus of this invention and adjusted desirably and securely. Therefore, the ~~given~~ pattern is accurately transferred onto substrates.

Please replace the paragraph beginning at page 14, line 26, with the following rewritten paragraph:

According to this, by performing exposure using the exposure apparatus of this invention, a ~~given~~ pattern is accurately transferred onto divided areas on a substrate, so that the productivity of highly integrated devices having a fine circuit pattern thereon can be improved.

Please insert the following paragraphs beginning at page 15, line 3:

According to a sixth aspect of the present invention, there is provided a wave-front aberration measuring method with which to measure wave-front aberration of a projection optical system that projects a pattern onto a substrate, the measuring method comprising: measuring aberration components of a second set of orders out of aberration components of a first set of orders included in wave-front aberration of the projection optical system; and correcting the measured aberration components of the second set of orders based on predetermined orders that are included in aberration components of the first set of orders and not included in aberration components of the second set of orders.

According to a seventh aspect of the present invention, there is provided a wave-front aberration measuring apparatus which measures wave-front aberration of a projection optical system that projects a pattern onto a substrate, the measuring apparatus comprising: a measuring system arranged in the projection optical system, which measures aberration components of a second set of orders out of aberration components of a first set of orders included in wave-front aberration of the projection optical system; and a correcting unit

coupled to the measuring system, which corrects the measured aberration components of second set of orders based on predetermined orders that are included in aberration components of the first set of orders and not included in aberration components of the second set of orders.

Please replace the paragraph beginning at page 17, line 9, with the following rewritten paragraph:

Fig. 1 shows the schematic construction and arrangement of an exposure apparatus 100 according to this embodiment, which is a projection exposure apparatus of a step-and-scan type. This exposure apparatus 100 comprises an exposure-apparatus main body 60 and a wave-front-aberration measuring ~~unit~~ apparatus 70.

Please replace the paragraph beginning at page 23, line 20, with the following rewritten paragraph:

In addition, the storage unit 28 constituted by, e.g., a hard disk is connected to the main control system 20, and comprises a correction-information store area AMIA for storing correction-information AMI for correcting the result of measuring the wave front aberration by the wave-front-aberration measuring ~~unit~~ apparatus 70 described later and a corrected-wave-front-aberration data store area AWFA for storing wave-front-aberration data AWF corrected using the correction-information AMI, the wave-front-aberration data AWF and correction-information AMI being described later.

Please replace the paragraph beginning at page 24, line 3, with the following rewritten paragraph:

The wave-front-aberration measuring ~~unit~~ apparatus 70 comprises a wave-front sensor 90 and a wave-front-data processing unit 80.

Please replace the paragraph beginning at page 27, line 15, with the following rewritten paragraph:

Next, the measurement of the wave-front-aberration ~~in~~ of the projection optical system PL and the exposure operation will be described. In the below description, the wave-front-aberration measuring ~~unit~~ apparatus 70 measures aberration components (coefficients $Z_2$ through $Z_M$ in the above equation (1)) of the second through M'th (e.g. M=36) ~~order terms~~

orders when the wave-front aberration is expanded in terms of fringe Zernike polynomials. And the word "order" means the order associated with each term of the wave-front aberration expanded in terms of fringe Zernike polynomials. Furthermore, it is assumed that the precise, mathematical model for the wave-front sensor 90 of the wave-front-aberration measuring ~~unit~~ apparatus 70 is known.

Please replace the paragraph beginning at page 27, line 28, with the following rewritten paragraph:

Yet further, it is assumed that aberration components of (M+1)'th order and over hardly vary between before and after installing the projection optical system PL in the exposure apparatus 100, which assumption is, from experience, known to be correct. Moreover, it is assumed that the result of measuring the wave-front aberration not having components of (M+1)'th order and over hardly varies between upon very accurate measurement and when using the wave-front-aberration measuring ~~unit~~ apparatus 70.

Please replace the paragraph beginning at page 28, line 10, with the following rewritten paragraph:

First, correction-information AMI stored in the correction-information store area AMIA of the storage unit 28 in Fig. 1 will be described which is obtained before the wave-front-aberration measuring ~~unit~~ apparatus 70 measuring the wave-front aberration ~~in~~ of the following manner.

Please replace the paragraph beginning at page 28, line 16, with the following rewritten paragraph:

First, in a step 121 of Fig. 6, for the position (image height) of each of pinhole features $PH_j$ (j=1 through J) (refer to Fig. 9) of a measurement reticle RT described later, aberration components $Z0_{j,2}$ through $Z0_{j,N}$ (corresponding to coefficients $Z_2$ through $Z_N$ in the above equation (1)) of the second through N'th (N>M) ~~order terms~~ orders when the wave-front aberration ~~in~~ of the projection optical system PL is expanded in terms of fringe Zernike polynomials are measured. This measurement is performed when making the projection optical system PL before installing the projection optical system PL in the exposure apparatus 100. Therefore, it is possible to spend much time and much of measurement resources on the measurement, so that the wave-front aberration ~~in~~ of the projection optical system PL is very accurately measured. Incidentally, a Fizeau interferometer, etc., is used in the measurement.

Please replace the paragraph beginning at page 29, line 9, with the following rewritten paragraph:

In the actual making of the projection optical system PL, measuring the aberration components of the second through N'th ~~order terms~~ orders and, based on the measuring result, adjusting for the wave-front aberration are repeated, so that the wave-front aberration characteristic of the projection optical system PL is finally adjusted to be a desired one. The aberration components $Z0_{j,2}$ through $Z0_{j,N}$ measured in the step 121 and used in later steps are ones after the final adjustment. Aberration components of higher than N'th ~~order terms~~ orders exist in practice, but are assumed to be negligible. For example, in the case of lenses

usually used in the projection optical system PL, because of their shape, aberration components of higher ~~order terms~~ orders than the highest order ~~term~~ of the wave-front aberration measured in the making of the projection optical system PL are small enough for the assumption to be true.

Please replace the paragraph beginning at page 30, line 1, with the following rewritten paragraph:

Next, in a step 123, the second through M'th order aberration components $ZA_{j,2}$ through $ZA_{j,M}$ are calculated by a simulation based on the higher-order aberration wave-front $WA_j$ and a mathematical model of the wave-front sensor 90, which would be obtained by the wave-front-aberration measuring ~~unit~~ apparatus 70 measuring the higher-order aberration wave-front $WA_j$. The aberration components $ZA_{j,2}$ through $ZA_{j,M}$ calculated represent amounts by which the aliasing, etc., cause the (M+1)'th through N'th order aberration components to blend into the second through M'th order components. The aberration components $ZA_{j,2}$ through $ZA_{j,M}$ calculated are stored as correction-information AMI in the correction-information store area AMIA of the storage unit 28 via a communication line or storage medium.

Please replace the paragraph beginning at page 34, line 4, with the following rewritten paragraph:

It is noted that the measurement result of the wave-front aberration obtained by the wave-front-aberration measuring ~~unit~~ apparatus 70 may include components due to position

deviation of the upper surface of the mark plate 91 of the wave-front sensor 90 from the image plane of the projection optical system PL, on which a pinhole image of the pinhole-like feature $PH_1$ is formed, as well as the wave-front aberration due to the projection optical system PL, which components are caused by tilt, position deviation in the optical-axis direction and so forth. Therefore, the position of the wafer stage WST is controlled based on the deviation components calculated based on wave-front-aberration data obtained by the wave-front-aberration measuring ~~unit~~ apparatus 70, so that very accurate wave-front-aberration measurement is possible.

Please replace the paragraph beginning at page 36, line 2, with the following rewritten paragraph:

Subsequently, in the step 115 the wave-front-aberration calculating unit 33 reads out the detection result of the spot image positions from the position data store area 42 and calculates the aberration components (coefficients) $ZM_{1,2}$ through $ZM_{1,M}$ of the second through M'th ~~order terms~~ orders of the wave-front-aberration of light through the first pinhole-like feature $PH_1$ of the measurement reticle RT due to the projection optical system PL. The aberration components $ZM_{1,2}$ through $ZM_{1,M}$ are calculated as coefficients of fringe Zernike polynomials based on the differences between spot image positions expected if no wave-front-aberration exists and the spot image positions detected. Because the method of calculating aberration components is known, the description thereof is omitted.

Please replace the paragraph beginning at page 37, line 17, with the following rewritten paragraph:

Also when moving the upper surface of the mark plate 91 of the wave-front sensor 90 to the image plane on which an image of the pinhole-like feature $PH_2$ is formed, the position of the wafer stage WST is, as described above, controlled based on the above position-deviation components calculated based on wave-front-aberration data obtained by the wave-front-aberration measuring ~~unit~~ apparatus 70, which control is preferably performed for each pinhole-like feature.

Please replace the paragraph beginning at page 39, line 4, with the following rewritten paragraph:

In the step 102, the main control system 20 checks based on the wave-front-aberration-measurement result $ZF_{j,i}$ from the wave-front-aberration measuring ~~unit~~ apparatus 70 (more exactly the controller 39) whether or not the wave-front-aberrations due to the projection optical system PL are at or below a permissible limit. While, if the answer is YES, the process proceeds to a step 104, if the answer is NO, the process proceeds to a step 103. At this point of time the answer is NO, and the process proceeds to the step 103.

Please replace the paragraph beginning at page 40, line 8, with the following rewritten paragraph:

In the step 104, after the wave front sensor 90 has been removed from the wafer stage WST, and the wave-front-data processing unit 80 is disconnected from the main control system 20, a reticle loader (not shown) loads a reticle R having a ~~given~~ pattern formed thereon onto the reticle stage RST under the control of the main control system 20, and a wafer loader (not shown) loads a wafer W subject to exposure onto the wafer stage WST.

Please replace the paragraph beginning at page 42, line 15, with the following rewritten paragraph:

As described above, according to this embodiment, when obtaining the aberration components $ZF_{j,i}$ (i= 2 through M) of the second through M'th ~~order terms~~ orders of the projection optical system PL installed in the exposure apparatus 100, based on the aberration

components (coefficients) $Z0_{j,M+1}$ through $Z0_{j,N}$ of the (M+1)'th through N'th (N>M) ~~order terms~~ orders accurately measured before, the correction amounts $ZA_{j,i}$ are calculated which represent amounts of the aberration components (coefficients) $Z0_{j,M+1}$ through $Z0_{j,N}$ of the (M+1)'th through N'th ~~order terms~~ orders that blend into the aberration components $ZM_{j,i}$ of the second through M'th ~~order terms~~ orders measured by the wave-front-aberration measuring ~~unit~~ apparatus 70. And the aberration components $ZM_{j,i}$ of the second through M'th ~~order terms~~ orders measured by the wave-front-aberration measuring ~~unit~~ apparatus 70 are corrected with the correction amounts $ZA_{j,i}$ to obtain the aberration components $ZF_{j,i}$. Therefore, the aberration components $ZF_{j,i}$ of the second through M'th ~~order terms~~ orders of the wave-front aberration ~~in~~ of the projection optical system PL can be accurately obtained.

Please replace the paragraph beginning at page 43, line 7, with the following rewritten paragraph:

Furthermore, because the projection optical system PL is adjusted in terms of the wave-front aberration based on the accurately calculated wave-front aberration due to the projection optical system PL, and a ~~given~~ pattern of a reticle R is projected onto a wafer W through the projection optical system PL that causes little aberration, the ~~given~~ pattern can be very accurately transferred on the wafer W.

Please replace the paragraph beginning at page 44, line 18, with the following rewritten paragraph:

In addition, although in the above embodiment the correction amounts $ZA_{j,i}$ represent amounts of the aberration components (coefficients) $Z0_{j,M+1}$ through $Z0_{j,N}$ of the (M+1)'th through N'th ~~order terms~~ orders that blend into the aberration components $ZM_{j,i}$ of the second through M'th ~~order terms~~ orders measured by the wave-front-aberration measuring ~~unit~~ apparatus 70, instead of the values $ZA_{j,i}$ the higher-order aberration wave-front $WA_j$ may be used as the correction-information AMI. In this case, the process by the main control system 20 in the step 118 of Fig. 8 is as follows.

Please replace the paragraph beginning at page 45, line 1, with the following rewritten paragraph:

First, the main control system 20 calculates an aberration wave-front $WB_j$ in which the second through M'th ~~order terms~~ orders' coefficients are the aberration components $ZM_{j,i}$ respectively, based on the aberration components $ZM_{j,i}$ measured by the wave-front-aberration measuring ~~unit~~ apparatus 70. Subsequently, the main control system 20 reads out the higher-order aberration wave-front $WA_j$ from the correction-information store area AMIA of the storage unit 28 and calculates a corrected wave-front $WC_j$ using the equation (4)

$$WC_j = WB_j - WA_j. \qquad (4)$$

Please replace the paragraph beginning at page 45, line 12, with the following rewritten paragraph:

Next, the main control system 20 calculates based on the corrected wave-front $WC_j$ and a mathematical model of the wave-front sensor 90 aberration components $ZF_{j,i}$' that would be obtained when the wave-front-aberration measuring ~~unit~~ apparatus 70 measured the corrected wave-front $WC_j$, which components $ZF_{j,i}$' are equivalent to the final aberration components $ZF_{j,i}$, which are obtained in the above embodiment.

Please replace the paragraph beginning at page 46, line 6, with the following rewritten paragraph:

Furthermore, although in the above embodiment the orders of the aberration components measured by the wave-front-aberration measuring ~~unit~~ apparatus 70 are continuous, the orders may be not continuous or intermittent. In this case, the corrected wave-front corresponding to the higher-order aberration wave-front $WA_j$ can be calculated using the prior measuring result for aberration components not measured by the wave-front-aberration measuring ~~unit~~ apparatus 70.

Please replace the paragraph beginning at page 46, line 15, with the following rewritten paragraph:

In addition, although the above embodiment describes the case where after the wave-front-aberration measuring ~~unit~~ apparatus 70 measures the wave-front aberration ~~in~~ of the projection optical system PL the measuring result is corrected, it is possible to measure the

wave-front aberration using a measurement reticle RT' (hereinafter, called a "reticle RT'" as needed) described in the following and to correct the measuring result in the same way as in the above embodiment. In this modified example the main control system 20 further comprises the function of the wave-front-aberration calculating unit 33.

Please replace the paragraph beginning at page 53, line 17, with the following rewritten paragraph:

Based on the position deviation data obtained from the R measurement points (corresponding to the areas $S_{p,q}$) within the field of the projection optical system PL, the main control system 20 calculates the aberration components of the first through M'th ~~order terms~~ orders of the series in which the wave-front (wave-front aberration) is expanded, and corrects the calculating result in the same way as in the above embodiment.

Please replace the paragraph beginning at page 55, line 21, with the following rewritten paragraph:

It is remarked that although in the above embodiment cross talk between ~~order terms~~ orders is corrected for in which higher-order aberration components blend into lower-order aberration components, cross talk between lower~~-order terms~~ orders can also be corrected for, in which case, when calculating the correction information before, the amounts of cross talk between lower~~-order terms~~ orders are also calculated based on a mathematical model for the wave-front-aberration measuring ~~unit~~ apparatus 70 in order to obtain the correction information.

Please replace the paragraph beginning at page 56, line 3, with the following rewritten paragraph:

In addition, although in the above embodiment the wave-front aberration is expanded in a set of fringe Zernike polynomials as a basis (or series), another basis can be used to expand the wave-front aberration in to obtain aberration components of desired ~~order terms~~ orders.

Please replace the paragraph beginning at page 56, line 16, with the following rewritten paragraph:

Furthermore, although in the above embodiment the wave-front-aberration measuring ~~unit~~ apparatus 70 is removed from the exposure-apparatus main body 60 before exposure, needless to say, exposure may be performed without removing the wave-front-aberration measuring ~~unit~~ apparatus 70.

## IN THE SPECIFICATION

Please replace the Abstract of the Disclosure beginning at page 66, with the following amended paragraph: